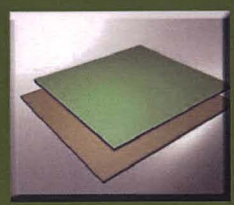
ADVANCES IN COMPOSITE MATERIALS



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Chapter 025

An Investigation of Hybrid Composites Tubes Subjected to Quasi-Static Loading

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Keywords: Composites, hybrid, carbon fiber, glass fiber, compressive load.

Abstract: In this chapter, the results of experimental works pertaining to the crash behaviour, collapse modes and energy absorption capability of hybrid composites that were subjected to quasi-static axial compressive loading are presented. The tested specimens were featured by a material combination of carbon fibers and glass fibers in thermosetting epoxy resin. Two stacking sequence of the hybrid composites were selected. These hybrids composites were hybrid with carbon fiber in the inner side and glass fiber in the outer side of tubes (HBCG) and vice versa (HBGC). These hybrids tubes were compressed under the load of 1000kN. The influence of the most important specimen such as the tube axial length, wall thickness on the compressive response and collapse modes of the tested tubes is thoroughly analysed. In addition, the effect of laminate materials properties such as the fiber volume content and stacking sequence on the energy absorbing capability of the thin walls is also examined. Results show that stacking the sequence influence the collapse mode of the hybrid tubes. Independently of the collapse mode, the peak compressive load increases significantly as the number of fiber reinforcing layers, fiber volume content and thickness of the axially compressed tubes increases.

Introduction

Composites tubes are found to be excellent crashworthy structures due to their superb energy absorption performance during the progressive crushing under axial loadings. Several types of crashworthy components in the forms of different material systems, various geometrical shapes and multifarious fabrication methods were developed and subjected to axial compression examinations [1-5]. However, only a few works focused on the for hybrid composites axial crushing performance can be retrieved [6-7].

The main reason for the study in this area is due to ability to combine the two or more types of reinforcement in such a way as to tailor the material to the exact needs of application [7]. Based on the fact that advantages found with one type of fiber can be used to complement the poor performance of other type for a particular property, the crushing behaviour of structure made of carbon fiber reinforced polymer composites can be optimized by hybridization with glass fiber reinforced polymer composites. Chiu et al [7] investigated the crush failure modes of two-dimensional triaxially braided hybrid composite tubes. It is observed that the crush failure modes and energy absorption of the braided composites were strongly influenced by the fiber types and their hybrid kind. The objective of this work is to